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ABSTRACT

This manual was designed to assist Minnesota's schools in minimizing the consumption of lead in drinking water by students and staff. It offers step-by-step instructions for testing and reducing lead in drinking water. The manual answers: Why is lead a health concern? How are children exposed to lead? Why is lead a special concern for schools? How does lead get into drinking water? How much lead in drinking water is too much? and What can be done to reduce lead levels in drinking water? This last question includes discussion of legal background and requirements, testing for lead in school drinking water, flushing taps, testing taps, flushing and retesting, other corrective actions, and reassessment. (Contains a glossary. Appendices contain a list of Minnesota laboratories certified to analyze lead in drinking water, and a lead testing record form. Also contains a list of other resources.) (EV)

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Reducing Lead in Drinking Water: A Manual for Minnesota's Schools

Minnesota Department of Health
Minnesota Department of Children, Families, and Learning

April, 2000

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REDUCING LEAD IN DRINKING WATER:
A Manual for Minnesota's Schools

Minnesota Department of Health
Section of Drinking Water Protection

Minnesota Department of Children,
Families, and Learning
Division of Management Assistance

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REDUCING LEAD IN DRINKING WATER: A MANUAL FOR MINNESOTA'S SCHOOLS

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INTRODUCTION

What Is The Purpose of This Manual?

This manual was designed to assist Minnesota's schools in minimizing the consumption of lead in drinking water by students and staff. Following are step-by-step instructions for testing and reducing lead in drinking water.

Who Should Read This Manual?

This manual is intended for use by all public and private schools in Minnesota. School administrators should review this manual and implement activities to reduce lead levels at all taps used for drinking water or in food preparation. The specific instructions provided regarding testing and corrective actions are designed for school health, safety, and maintenance personnel, as well as any consultants working with educational agencies to reduce lead levels in drinking water.

WHY WORRY ABOUT LEAD IN SCHOOLS?

Why Is Lead A Health Concern?

Lead is a toxic material, known to be harmful to human health if ingested or inhaled. Lead in the body can damage the brain, kidneys, nervous system and red blood cells. Children, infants, pregnant women and their unborn children are especially vulnerable to lead. In children, lead has been associated with impaired mental and physical development, as well as hearing problems. The harmful effects of lead in the body can be subtle and may occur without any obvious signs of lead poisoning.

Blood lead levels as low as 10 micrograms per deciliter (μg/dL) are associated with harmful effects on children's learning and behavior. In 1997, the Centers for Disease Control and Prevention (CDC) estimated that 890,000 children in the United States had blood lead levels greater than or equal to 10 μg/dL. Reducing any and all sources of exposure to lead can help reduce the number of children with elevated blood lead levels.

How Are Children Exposed to Lead?

Lead in the Environment

Children can be exposed to lead in many ways. Before action was taken to reduce lead in the environment, it was used in paint, gasoline, plumbing components, and many other products. Children may be exposed to lead in such sources as: lead-based paint found in pre-1978 housing, lead-contaminated dust and soil, drinking water, and lead-containing materials used in adult occupations and hobbies. It is important to consider all these sources when determining a child's overall exposure to lead, because several lower amounts of lead may potentially add up to a significant total exposure.

Lead in Drinking Water

Drinking water is not typically the primary source of lead exposure for children, but it can contribute to total lead exposure (see table below). Reducing the amount of lead in drinking water is an important part of reducing a child's overall exposure to lead in the environment.

Common Sources of Lead

Lower Doses
- Drinking water
- Air

Higher Doses
- Lead-contaminated household dust
- Dust and chips from exterior lead-based paint removal
- Dust and chips from interior lead-based paint removal
- Lead-contaminated soil
- Industrial sources of lead
- Lead-containing materials used in adult occupations or hobbies

Adapted from *Lead Poisoning and Children* (MDH/Freshwater Foundation 1992)

Why Is Lead A Special Concern for Schools?

Children Are More Vulnerable to Lead

Amounts of lead that won't hurt adults can slow down the normal physical and mental development of growing bodies. Growing children will also more rapidly absorb any lead they consume. In addition, children at play come into contact with more sources of lead – such as dirt and dust – than do adults.

Water Use Patterns at Schools

The "on-again, off-again" water use patterns of most schools can result in elevated lead levels in drinking water. Water that remains stagnant in plumbing overnight, over a weekend, or during a vacation is in longer contact with plumbing materials and may therefore contain higher levels of lead.

How Does Lead Get Into Drinking Water?

Lead generally enters drinking water from a building's plumbing system. Lead may be present in various parts of the plumbing system (such as lead solder, brass fixtures, and lead pipes) and is picked up by the water passing through the plumbing system. The amount of lead, if any, in a plumbing system will depend on the age of the system and the materials from which the system was constructed.

The amount of contact time between water and any lead source is the greatest contributing factor to lead in drinking water. The longer water remains standing in the plumbing system, the greater the potential for it to absorb lead from any lead sources present. For this reason, the lead concentration is at its highest when water has remained unused overnight or over a weekend. Additionally, factors such as water chemistry and temperature can affect the rate at which water absorbs lead.

How Much Lead In Drinking Water Is Too Much?

The United States Environmental Protection Agency (US EPA) recommends that school drinking water not exceed 20 parts per billion (ppb) of lead. However, all schools should seek to reduce the amount of lead in drinking water to as close to zero as possible.

What Can Be Done To Reduce Lead Levels In Drinking Water?

You can do three things to reduce lead levels in drinking water:

1 *Use Only Cold Water for Drinking and Food Preparation.*
Hot water is likely to contain higher levels of lead than cold water. Only water from the cold water tap should be used for drinking, preparing juice, mixing baby formula, or cooking. Boiling the water will not remove the lead and may increase the concentration of lead in the water.

2 *Flush Taps Before Use.*
The more time water has been standing in the plumbing system, the more lead it may contain. Running water at a tap, usually for 2-3 minutes, prior to using it for drinking or food preparation will often reduce lead levels in the water. Lead in drinking water is typically an "endpoint" problem, with the highest concentrations of lead near the tap. Flushing works by removing water with the most lead from the drinking water system.

Until a tap is tested, drinking water should be assumed to contain lead, and the water at these taps should be flushed twice a day (in the morning and at midday).

3 *Test the Water for Lead.*
The only way to determine how much lead is present in the drinking water at your school is to have the water tested for lead. Each tap or fixture providing water for drinking or cooking purposes should be tested for lead at least every five years. Corrective action should then be taken at taps with elevated lead levels.

More detailed instructions on testing water for lead and information about corrective actions can be found on page 8.

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Legal Background and Requirements

The following two federal laws currently pertain to lead in school drinking water:

The Lead Contamination Control Act (LCCA) of 1988

This law applies to all schools, whether they purchase water from a water utility (i.e. city or rural water) or they supply their own water (i.e. well). The intent of the LCCA is to identify and reduce lead in drinking water at schools and day care facilities. It relies on voluntary compliance by individual schools and school districts. The United States Environmental Protection Agency (US EPA) developed guidelines to assist schools in reducing lead in drinking water. In this 1994 document, "Lead in Drinking Water in Schools and Non-Residential Buildings," the US EPA recommended a lead limit of 20 ppb for school drinking water, based on 250 ml first draw samples. The MDH document you are currently reading is based on the US EPA document and the requirements of the LCCA. If you would like a copy of "Lead in Drinking Water in Schools and Non-Residential Buildings," you may request one from MDH (see contact information on the back cover of this booklet).

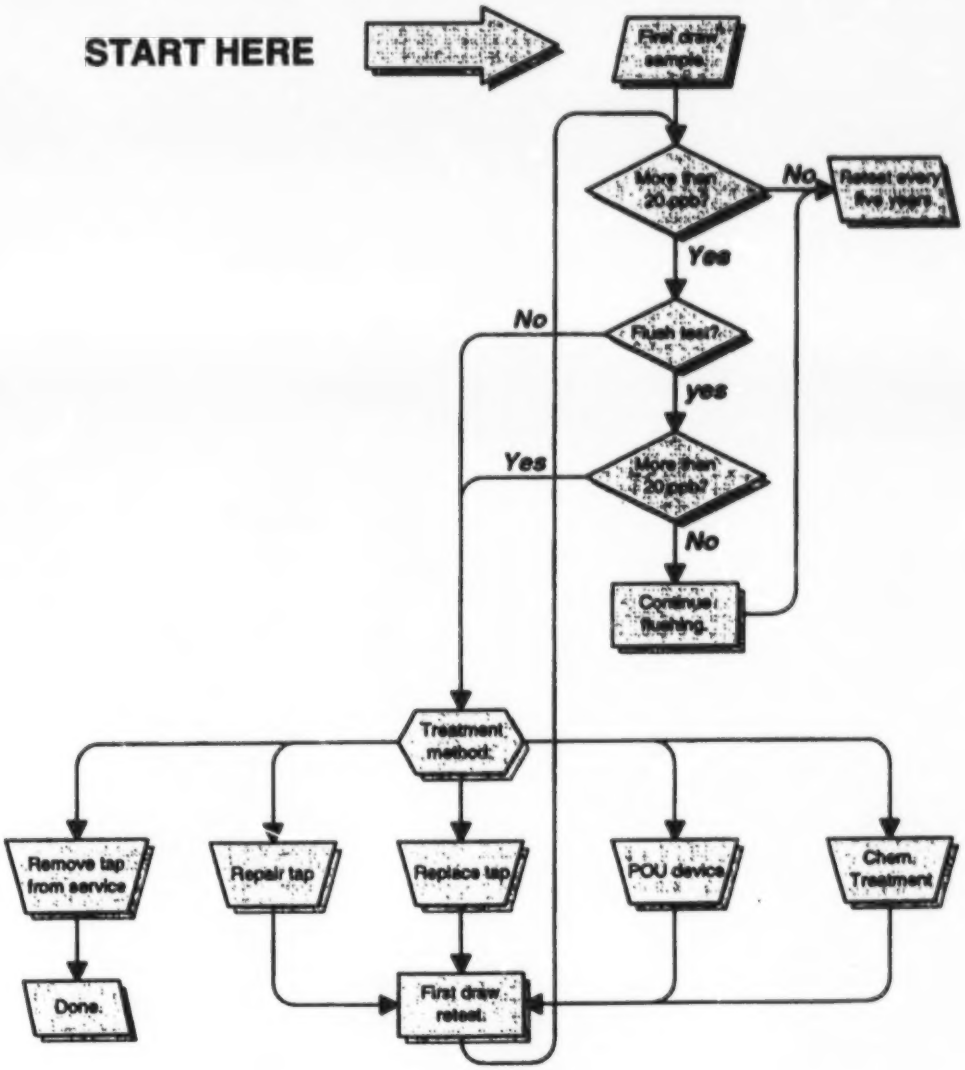
The Safe Drinking Water Act (SDWA), Lead and Copper Rule

This law applies only to schools that provide their own water supply. Compliance with the Lead and Copper Rule is mandatory for those schools that supply their own water. Under the Lead and Copper rule, no more than ten percent (10%) of the samples from a school's drinking water taps may exceed the lead "action level" of 15 ppb. The "action level" is the level at which action must be taken to protect the public health. If the "action level" is exceeded, the school is legally required to take corrective action. A one liter (1000 ml), first draw, cold water sample is used for monitoring under the Lead and Copper Rule (note that this volume is different than that for sampling recommended in this document).

Please note that schools providing their own water are affected by both the LCCA and the Lead and Copper Rule. You may consult with the MDH for assistance in understanding and complying with both of these laws.

Testing for Lead in School Drinking Water

The process of testing for lead in drinking water is explained in detail on the following pages.



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Detailed Instructions

Step 1: Flush Taps

Flushing the drinking water taps (letting them run) often works to reduce lead in drinking water.

> *Until lead testing has been done, each water tap used for drinking or food preparation should be flushed twice each day the school is in use (in the morning before school begins and at midday).*

Flushing consists of opening a tap or combination of taps to clear standing water that has been in contact with components of the plumbing system that may contain lead. A school's water system can be flushed in two ways:

1 Flush Individual Drinking Water Taps

Running the water for 2-3 minutes at each drinking water tap will, in most cases, remove water that has been in contact with lead-containing plumbing materials. This type of flushing is frequently effective because lead sources are often contained in plumbing within the tap or very near the tap. Please note that refrigerated water coolers will take much longer to flush than other taps, because flushing must be long enough to remove all water from the cooling tank in the unit (this may take up to 15 minutes).

OR

2 Flush Main Pipes, Then Flush Individual Drinking Water Taps

Do this when: 1) many taps in an area will need to be flushed, or 2) it is believed that there are lead sources throughout the plumbing system, a more extensive method of flushing is appropriate. In these situations, water should first be flushed from the drinking water tap which is furthest from the water source on the main pipe(s). Water at this tap should be flushed for ten (10) minutes unless the time needed to clear water from the main pipes of the plumbing system has been specifically calculated (plumbing diagrams, flow rates, and other system information can be used to calculate the time needed for flushing). Next, all other drinking water taps need to be flushed long enough to remove water from those taps back to the primary flushed line.

> *Flushing alone should not be used as a substitute for testing. The only way to identify and correct lead problems is to test for lead in drinking water. Testing instructions are given on the following pages.*

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Step 2: Test Taps

Water from all taps used for drinking or food preparation should be tested for lead, using "first draw" samples. "First draw" means that the samples are to be collected before the fixture is used or flushed during the day. US EPA recommends that water should sit in the pipes unused for at least 8 hours (but not more than 18 hours) before a sample is taken. Use only cold water for collecting lead samples.

Collecting the sample

- Sample Size: 250 ml

- Analytical Laboratory: Only laboratories certified to analyze lead in drinking water should be used. A list of these laboratories is provided at the end of this document. The laboratory will provide you with sample bottles and instructions for submitting samples.

- Field Test Kits: A type of field test kit is now available that uses a method certified by US EPA for lead analysis (anodic stripping voltammetry method). If you are interested in using a field test kit, contact MDH for assistance.

Interpreting first draw results

- Make sure your results are in parts per billion (ppb). See the Glossary on page 13 to convert from other units to ppb.

- If lead is at or below 20 ppb, no flushing is required for the tap (except for schools using their own water supply with exceedances under the SDWA Lead and Copper Rule). The tap may continue to be used for drinking water and should be retested in five years.

- If lead exceeds 20 ppb, continue the twice daily flushing. Go to "Step 3: Flushing and Retesting" to ensure that flushing is effective and that lead levels remain below 20 ppb.

- Test results more than five years old may not be valid. All taps should be sampled on a five year frequency or sufficient samples should be taken over time within a building to show consistent low readings. If sampling is to be spread over several years, then testing should first be done for drinking water taps used by younger children and pregnant women.

Step 3: Flushing and Retesting

Each tap that exceeds the 20 ppb lead standard is to be flushed in the morning and retested near lunchtime, just prior to the midday flushing. This is to determine if lead levels rise above 20 ppb during a four to six hour period of use (taps may be used during the morning, before the midday sample is collected).

Interpreting midday results:

- If the midday test sample shows lead at or below 20 ppb, the tap can be used, but twice daily flushing must continue indefinitely, unless another type of corrective action (see Step 4) is implemented.

- If the midday test result exceeds 20 ppb, flushing has not been effective. Either the flushing program should be altered (longer flush time, more thorough flushing, etc.) and re-evaluated, or the tap should be taken out of service until a corrective action (as discussed in Step 4) is taken. Once the corrective action is completed, the tap is to be retested (as discussed in Step 5) before it is used.

Step 4: Other Corrective Actions

Further corrective actions need to be implemented when midday samples exceed 20 ppb (following a morning flush). Corrective actions can also be taken to completely eliminate the need for flushing at any taps where first draw samples exceed 20 ppb. After a corrective action is implemented, the tap is to be retested (see Step 5) to ensure the lead level is reduced to 20 ppb or less.

Plans and specifications for the plumbing system may be useful for identifying the source of lead and, therefore, help in determining the appropriate treatment option.

Options for corrective action:

- Remove Tap From Service: If the tap is seldom used, it may be disconnected from the water supply line and be removed. However, you must first verify with your local/state plumbing or building code official that the tap is not required for code compliance.

- Replace Tap: A tap can be replaced with a new one if the existing tap is suspected to be the source of contamination. Many metallic taps, even new ones, may contain lead which can contaminate the water. Please check with the manufacturer to determine the lead content of the tap. To minimize the introduction of lead, the tap should meet National Sanitation Foundation (NSF) Standard 61. See the definitions section of this document for more information on "lead free" taps.

- Replacement and Repair: Replace suspected sources of lead, including lead pipe, lead solder joints, brass plumbing components, and brass faucets.

- Point-of-Use Water Treatment Device: A point-of-use water treatment device may be installed at taps which are exceeding 20 ppb of lead. The device should be approved as meeting NSF Standard 53, NSF Standard 58, or an equivalent standard. It should be installed, operated, and maintained in accordance with the manufacturer's recommendations.

- Chemical Treatment of the Water Source/New Water Source: Changing the water chemistry may reduce the amount of lead absorbed by the water. This may be done by adding a chemical to the water as it enters the building. Methods of chemical treatment include addition of a phosphate inhibitor or an adjustment to the water's hardness. Another way to change water chemistry is to connect to a new water source that is less corrosive, which will cause less lead to be absorbed by the water.

Step 5: Reassessment

All taps affected by a corrective action (from Step 4) should be retested after the corrective action has been implemented. A first draw sample should be taken, using the procedure outlined in Step 2.

Interpreting post-corrective action results:

- If the analysis shows lead is at or below 20 ppb, no further action is required, as long as the corrective action remains in place. The next sample should be collected within 5 years.

- If the analysis shows lead to be above 20 ppb, twice daily flushing is required, and 1) a midday sample as specified in Step 3 is to be collected to determine if flushing is effective, or 2) a new corrective action can be implemented followed by retesting as specified in Step 2.

GLOSSARY

First Draw Sample

The first water drawn from a tap after the water has sat undisturbed in the plumbing system for at least eight hours (or overnight). Usually, the water is collected immediately in the morning before it can be used for other purposes. It is then analyzed for lead.

Flush

Running the water at a tap or combination of taps to clear standing water from the plumbing system. Flushing is used to reduce the amount of lead present in water consumed from the tap. See page 8 for description of how flushing is conducted.

Flush Sample

A sample of tap water that has been collected following the flushing of a drinking water tap.

Lead Free

The Safe Drinking Water Act (SDWA) defines "lead free" as follows:
- For solders and flux: Does not contain more than 0.2 percent lead.
- For pipes, pipe fittings, and well pumps: Does not contain more than 8.0 percent lead.

Since 1986, only "lead free" pipe, solder, or flux may be used in the installation or repair of 1) public water systems or 2) any plumbing in a residential or non-residential facility providing water for human consumption, which is connected to a public water system. Note that "lead free" taps may still contain some lead. The definition of "lead free" only addresses the amount of lead in the product, and is not based on the amount of lead that will leach into water.

NSF Standard 61, a voluntary standard, does consider the amount of lead that will be leached into the water. Taps meeting NSF Standard 61 should not leach more than 11 ppb of lead.

Parts Per Billion (ppb)

A unit of measurement equal to one microgram per liter. This measurement is commonly used to describe the concentration of lead in drinking water.
1 part per billion (ppb) = 1 microgram per liter (µg/l)
1000 parts billion (ppb) = 1 part per million (ppm) = 1 milligram per liter (mg/l)

Tap

Point of access for people to obtain water for drinking or cooking. A tap can be a fixture, faucet, drinking fountain, or water cooler. Drinking water taps typically do not include bathroom taps, hose bibbs, or custodial closet sinks.

APPENDIX 1: CERTIFIED LABORATORIES

MINNESOTA LABORATORIES CERTIFIED TO ANALYZE LEAD IN DRINKING WATER*

Lab Name	Phone Number	Address
A.W. Research Laboratories	(218) 829-7974	2403 Airport Road Northeast, Brainerd, MN 56401
American Science Corporation	(651) 291-9472	11 Empire Drive, St. Paul, MN 55103
ASCI Corporation, Environmental Testing Division	(218) 722-4040	4444 Airpark Boulevard, Duluth, MN 55811
Blair Environmental Laboratories, Inc.	(612) 617-9584	425 Hoover Street NE, Minneapolis, MN
Braun Intertec Environmental	(612) 941-5600	6875 Washington Avenue South, Eden Prairie, MN 55439
Eagan Environmental Services	(612) 454-3310	3385 South Highway 149, Eagan, MN 55121
Eco-Agri Laboratories, Inc.	(320) 235-3927	3009 East Highway 12, Willmar, MN 56201
ERA Laboratories	(218) 727-6380	24 N. 21st Avenue West, Duluth, MN 55806-2017
Horizon Laboratories, Inc.	(651) 653-3471	4463 White Bear Parkway, Suite 105, St. Paul, MN 55110
Instrumental Research, Inc.	(612) 571-3698	7800 Main Street NE, Fridley, MN 55432
Interpoll Laboratories, Inc.	(612) 786-6020	4500 Ball Road N.E., Circle Pines, MN 55014
JT Testing Service	(612) 434-9634	14755 Palm Street, Andover, MN 55304
Lake Superior Laboratories	(218) 722-1911	728 Garfield Avenue, Duluth, MN 55802
Legend Technical Services, Inc.	(651) 642-1150	739 Vandalia Street, St. Paul, MN 55114
Midwest Analytical Services, Inc.	(612) 689-2175	330 South Cleveland Street, Box 349, Cambridge, MN 55008
Minneapolis Health Department	(612) 673-2160	250 South 4th Street, Minneapolis, MN 55415-1372
Minnesota Valley Testing Laboratories	(507) 354-8517	1126 North Front Street, P.O. Box 249, New Ulm, MN 56073
Natural Resources Research Institute Central Analytical Lab	(218) 720-4316	5013 Miller Trunk Highway, Duluth, MN 55811
Northeast Technical Services	(218) 741-4290	315 Chestnut Street, P.O. Box 1142, Virginia, MN 55792
NSP Testing Laboratory	(612) 630-4439	1518 Chestnut Avenue, Minneapolis, MN 55403
St. Paul-Ramsey County Department of Public Health	(651) 292-7721	555 Cedar Street, St. Paul, MN 55101
SERCO Laboratories	(651) 636-7173	1931 W. County Road C-2, St. Paul, MN 55101
Spectrum Labs, Inc.	(651) 633-0101	301 West County Road E2, New Brighton, MN 55112
Twin City Water Clinic	(612) 935-3556	617 13th Avenue South, Hopkins, MN 55343
University of Minnesota Research Analytical Laboratory	(651) 625-9713	1903 Hendon Avenue, St. Paul, MN 55108
Utility Consultants Laboratory	(507) 234-5835	129 North Main Street, Janesville, MN 56408
Water Laboratories, Inc.	(612) 441-7509	333 East Main Street, P.O. Box 388, Elk River, MN 55330

*This list is current as of December 1999. Lab certification status may change. You may contact MDH for an updated list.

APPENDIX 2: LEAD TESTING RECORD FOR SCHOOL DRINKING WATER

School Name: _____

Tap/Site Name	Initial "First Draw" Sample		Sample Following Morning Flushing* (If Needed)		First Draw Sample Following Corrective Action† (If Needed)		Comments
	Date	Result (in ppb)	Date	Result (in ppb)	Date	Result (in ppb)	

*Collected just before lunch period.
†Corrective action may include: fixture replacement, repair, installation of treatment device, new water source, or chemical treatment of water.

Where Can I Get More Information About Lead In Drinking Water?

For more information, contact one of the following agencies:

- Minnesota Department of Health, Section of Drinking Water Protection, 651/215-0070, www.health.state.mn.us
- Minnesota Department of Children, Families, and Learning, 651/582-8748, www.cfl.state.mn.us

Additional Resources:

- Minnesota Department of Health, Lead Program, 651/215-0890, www.health.state.mn.us
- United States Environmental Protection Agency, Office of Ground Water and Drinking Water, www.epa.gov/OGWDW
- United States Environmental Protection Agency, Lead Programs, www.epa.gov/lead/leadpbed.htm
- United States Environmental Protection Agency, National Lead Information Center, 1/800/424-LEAD
- Unites States Environmental Protection Agency, Safe Drinking Water Hotline, 1/800/426-4791

To request this document in another format, such as Braille, large print or cassette tape, call 651/215-0770; TDD 651/215-0707 or call the Minnesota Relay Service toll-free at 1/800/627-3529 (ask for 651/215-0770).

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